Clarifying the role of gaze cues using biologically natural and unnatural faces

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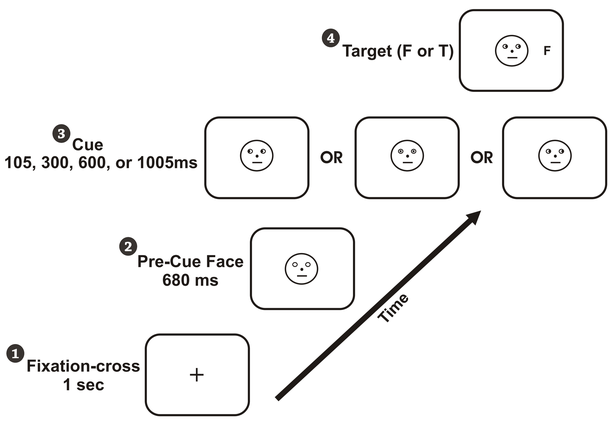
INTRODUCTION

- The use of perceived gaze direction to shift visual attention is known as **gaze cueing**. Gaze cueing is thought to rely on the neural mechanisms underlying face and gaze processing.
- Previous studies have reported that non-predictive gaze cues can elicit reflexive attentional orienting[1,2,3]. Here we sought to further clarify the role of gaze cues in attentional orienting by testing the extent to which the gaze cue effect depends on biologically natural gazes.

GAZE CUEING TASK

Figure 1: *General experimental paradigm.*



❶Trial starts with central fixation-cross presented for 1 sec.

❷Fixation-cross was replaced by pre-cue face stimulus (680ms), which was a simple schematic drawing of a face without eye pupils. Subjects were instructed to maintain eye fixation on the nose of the face.

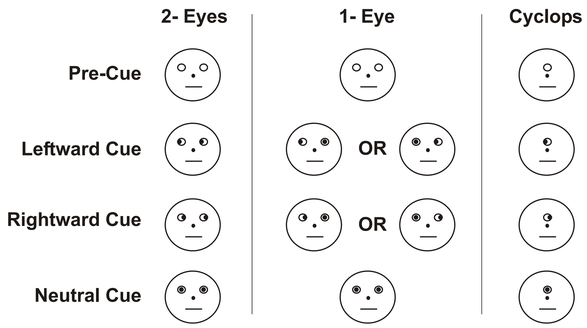
❸Cue consisted of presenting the eye pupils looking either left, right, or straight ahead for 105, 300, 600, or 1005ms (cue-target onset asynchrony, CTOA), randomly determined.

❹Target (F or T) was presented either to the right or left of the face (target letter and side of face were randomly determined). Subjects identified the letter by a speeded discrimination response.

- Gaze cues directed towards target were **valid cues.**
- Gaze cues directed away from target were **invalid cues.**
- Gaze cues pointing straight ahead were **neutral cues.**
- All cues were uninformative and subjects were told the direction of gaze did not predict target location.
- Eye position was recorded & analyzed off-line to ensure subjects maintained eye fixation throughout the trial.

FACE CONDITIONS

Figure 2: *Gaze cues in three Face Conditions*



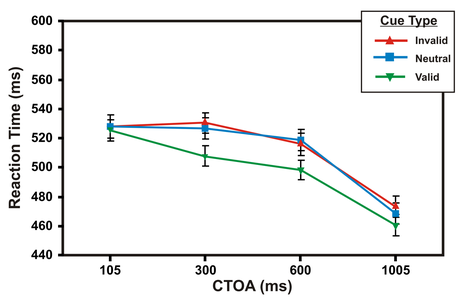
- Subjects performed the gaze cueing task in 3 different face conditions.
- **2-Eye condition**: both eyes looked in the same direction.
- **1-Eye condition**: only one eye looked left or right as the other eye looked straight ahead.
- **Cyclops condition**: a face with only one eye.

QUESTIONS:

1. Will reflexive orienting also be found in the **1-Eye** or **Cyclops** face conditions like in the **2-Eye** condition?
2. How will overall RT's compare among the 3 face conditions?

2-EYE GAZE CUEING

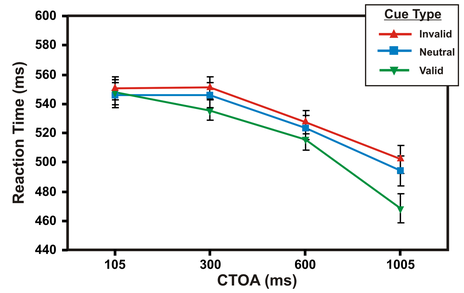
Figure 3: *Main results of 2-Eye condition (n = 53)*



- Valid cues elicited significantly faster RT's compared to invalid and neutral cues at the 300 and 600ms CTOA's ($p < 0.01$ for all comparisons).
- No RT facilitation in response to valid cues at the 105 and 1005ms CTOA's.
- Overall RT decreased as CTOA increased ($p < 0.01$).
- These results replicated findings from previous studies indicating that biologically natural gaze cues can elicit reflexive attentional orienting.

1-EYE GAZE CUEING

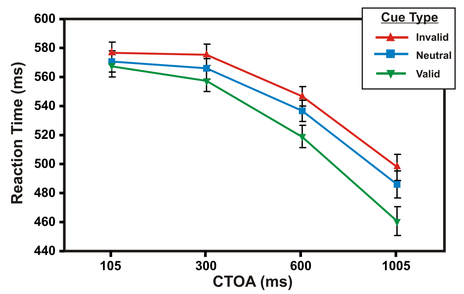
Figure 4: *Results in 1-Eye condition (n = 53)*



- Only at the 1005ms CTOA were RT's in response to valid cues faster compared to neutral and invalid cues ($p < 0.01$ for both comparisons).
- As in the 2-Eye condition, overall RT's decreased as CTOA increased ($p < 0.01$).

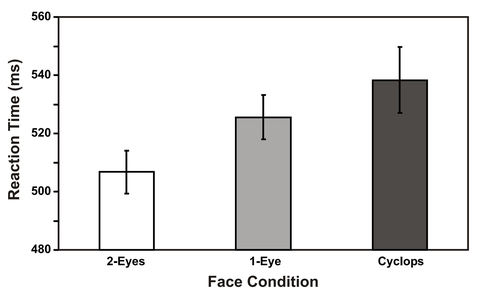
CYCLOPS GAZE CUEING

Figure 5: *Results in Cyclops condition (n = 53)*



- Faster RT's in response to valid cues compared to neutral and invalid cues were found all at the 600 and 1005ms CTOA's ($p < 0.01$ for all comparisons).
- As in the other conditions, overall RT's decreased as CTOA increased ($p < 0.01$).

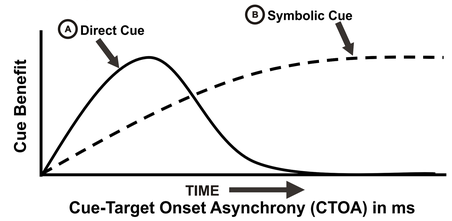
OVERALL RT'S BETWEEN FACE CONDITIONS



- Analysis of overall RT's revealed significant differences between Face conditions ($p < 0.01$).
- Overall RTs were slowest in the **Cyclops** condition and fastest in the **2-Eye** condition.

REFLEXIVE OR VOLITIONAL ORIENTING?

Figure 6: *Typical cue benefit effects elicited by direct cues and symbolic cues as a function of CTOA*



A Stimulus-driven attention orienting
- typically elicited by direct (or peripheral) cues.
- reflexive and involuntary.
- rapid and transient cue benefit.

B Goal-driven attention orienting
- typically in response to symbolic (or central) cues.
- volitional and involving interpretation.
- gradual and sustained cue benefit.

- Consistent with previous gaze cueing studies, our **2-Eye** results showing RT facilitation at 300 and 600ms CTOA's suggest that attentional orienting in response to uninformative biologically natural gaze cues is **stimulus-driven** (i.e., reflexive).
- Our **1-Eye** and **Cyclops** results showing RT facilitation only at later CTOA's (e.g., 1005ms) reflects more **goal-driven** attentional orienting (i.e., volitional).

CONCLUSIONS

- The purpose of our study was to further clarify the extent to which the gaze cue effect depends on biological relevance of the "face" and its gaze shifts.
- Results of the **2-Eye** condition are consistent with previous studies showing reflexive attentional orienting in response to non-predictive gaze cues resembling biologically natural gaze shifts.
- Biologically unnatural gaze cues in the **1-Eye** and **Cyclops** conditions yielded later onset of RT facilitation and overall slower RT's relative to the **2-Eye** condition.
- We conclude that reflexive orienting in response to gaze cues depends on the biological relevance of the face stimuli, specifically with respect to the realism of the "face's" gaze shifts.

REFERENCES

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3) Ristic, J. & Kingstone, A. (2005). Taking control of reflexive social attention. *Cognition, 94*, B55-B65

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